

REMARKS/ARGUMENTS

Applicant submits this voluntary amendment to comment on the Office Action of June 18, 2003 in applicant's corresponding U.S. patent application 09/854,905, now U.S. patent No. 6,759,863, which is the parent patent application for the subject application.

Amendments to the Claims

By this response, there are now a total of 25 claims pending in this application. Claims 1–33, 58–70 and 72 have been canceled without prejudice or disclaimer to applicant's right to continuation and divisional applications.

In this response, claims 34, 36–39, 48, 50, 51 and 71 have been amended for clarity to more clearly claim the invention. In particular, claim 34 has been amended to recite a test circuit comprising a base ring oscillator circuit, a plurality of sub-circuits coupled to the base ring oscillator circuit; and, a control circuit to selectively couple the sub-circuits to the base ring oscillator circuit to produce different versions of a variable ring oscillator circuit associated with a selected sub-circuit. Claim 34 further recites that the test circuit conducts a separate test of at least one of the versions of the integrated circuit for each variable ring oscillator circuit.

Claims 36–39, 48, 50, 51 and 71 have been amended to make a distinction between the base ring oscillator circuit and the variable ring oscillator circuit. Further, claim 38 has been amended to depend from claim 36.

Support for these claim amendments is shown in the application as filed from line 27, page 21 to line 8, page 22. Accordingly, the Applicant submits that none of these claim amendments introduce new subject matter into the application.

Claim Rejections—35 U.S.C. §102

In paragraph 4 of the Office Action of June 18, 2003 in applicant's corresponding U.S. patent application 09/854,905, the Examiner for that case rejected claims 34–47 and 54–57 under 35 U.S.C. 102(e) as being anticipated by Bach (U.S. 6,544,807). In particular, the Examiner argued that Bach discloses (in Figs. 1 and 2) a test circuit for testing an IC on a wafer and that the test circuit has a ring oscillator circuit (104), a plurality of sub-circuits (110) coupled to the ring oscillator and a control circuit that provides the output signal 102 to selectively couple the sub-circuits to the ring oscillator (104). The Examiner further argued that the test circuit (100) conducts a separate test of the IC for each sub-circuit (110) selected by the control circuit.

In response, the applicant respectfully submits that the Examiner has misinterpreted the Bach reference and that Bach does not disclose each of the claimed features of amended claim 34. In particular, the pulse counter 110 of Bach is not a plurality of sub-circuits that can be selectively coupled to a base ring oscillator to form a variable ring oscillator. In fact, Bach teaches that the pulse counter 110 simply counts the number of pulses in the pulse output signal. Further, Bach teaches that the ring oscillator 104 oscillates at a frequency determined by the total propagation time of the pulse output 106 through the ring oscillator 104 (see col. 2, lines 32–43) and does not teach altering the structure of the ring oscillator.

In addition, in Fig. 7, Bach teaches two independent ring oscillators 702 and 704 and that only one of the ring oscillators is enabled depending on whether high-performance or low-leakage transistors are desired for use (see line 59, col. 5 to line 15, col. 6). Accordingly, Bach teaches the use of two separate ring oscillators rather than switching sub-circuits into a single base ring oscillator to create a variable delay ring oscillator.

In contrast, in the subject invention, amended claim 34 recites a test circuit for an integrated circuit that includes a base ring oscillator and a plurality of sub-circuits that can be switched into the base ring oscillator to create different versions of a variable ring oscillator. The test circuit conducts a separate test of the integrated circuit on at

least one of the versions of the variable ring oscillator. Advantageously, the base ring oscillator of the test circuit can be re-used by switching in various sub-circuits to create different versions of the variable ring oscillator. This reduces the amount of components needed for the test circuit. In no way does Bach teach or suggest re-using a base ring oscillator circuit in a test circuit.

With regards to claim 35, the Examiner argued that Bach discloses that each test conducted by the test circuit (100) is a parametric test.

In response, the Applicant respectfully submits that Bach does not teach parametric tests. The Applicant has reviewed the Bach reference and has not found such a teaching and respectfully requests the Examiner to point out the section of the Bach reference that teaches the use of parametric tests since the Applicant could not find such a teaching. The Applicant submits that Bach simply teaches measuring the delay of the ring oscillator and does not teach correlating the delay with a parameter such as resistance or capacitance.

In contrast, the testing conducted by the test circuit of the subject invention is in fact a parametric test since various types of sub-circuits can be switched into the base ring oscillator to test a particular parameter. These tests are outlined in Table 1 on page 23 of the application as filed. It is also clear from Figure 18 of the subject application that each of the sub-circuits allows for a particular parameter such as delay, resistance and capacitance, for example, to be individually tested.

With regards to claim 36, the Examiner argued that Bach discloses that the sub-circuits (110) when coupled to the ring oscillator circuit (104) change the frequency (because of the feedback signal) of oscillation of the ring oscillator circuit (104).

In response, the Applicant respectfully submits that Bach does not teach altering the frequency of operation based on feedback from the pulse counter (110). The Applicant has reviewed the Bach reference and has not found such a teaching and respectfully

requests the Examiner to point out the section of the Bach reference which teaches this point. Further, the Applicant submits that Bach does not realize varying the delay of the oscillator according to different parameters and using the change in oscillation frequency as a test result. In addition, the frequency of oscillation in the ring oscillator circuit taught by Bach does not change because there is no element that can provide a variable delay in the feedback loop. The feedback loop is simply required so that the ring oscillator can oscillate.

With regards to claims 45 and 46, the Examiner argued that Bach teaches that the test circuit is formed on the wafer with at least two metallization layers of the IC and one metallization layer and one polysilicon layer. The Applicant has reviewed the Bach reference and has not found such a teaching and respectfully requests the Examiner to point out the section of the Bach reference which teaches this point.

Accordingly, based on the above submissions, the Applicant respectfully submits that claim 34 is novel and inventive in comparison to the Bach reference. Furthermore, since claims 35 to 57 and 71 depend either directly or indirectly from claim 34, and include other patentable features, the Applicant respectfully submits that claims 35 to 57 and 71 are also novel and inventive in comparison to the Bach reference.

Claim Rejections – 35 U.S.C. §103

In paragraph 5 of the Office Action of June 18, 2003 in applicant's corresponding U.S. patent application 09/854,905, for that application, the Examiner rejected claims 37 to 43 under 35 U.S.C. §103 as being unpatentable over Bach in view of Deyhimy et al. (U.S. 5,204,559). In particular, the Examiner argued that Deyhimy et al. (hereafter Deyhimy) teach a sub-circuit (270, 280, 290, 300; see Fig. 6) that comprises a capacitive load (C_n) and a resistive load (R_n) to change the frequency of oscillation of the ring oscillator circuit. The Examiner then argued that it would be obvious for one of ordinary skill in the art at the time the invention was made to modify Bach's sub-circuit

with capacitive and resistive loads as taught by Deyhimy et al. for the purpose of changing the delay or frequency of Bach's ring oscillator.

In response, the Applicant respectfully submits that there is no basis to combine the Deyhimy and Bach references. The Bach reference is directed towards testing the performance of microelectronic circuits while the Deyhimy reference is directed towards correcting clock skew by incorporating programmable delay blocks into a clock signal path for an integrated circuit. Accordingly, a person skilled in the art would not combine these two references since they are directed to two quite different applications.

In addition, as explained previously, the Bach reference does not teach switching sub-circuits into a base ring oscillator to form a variable ring oscillator. The Deyhimy reference also does not teach selectively switching sub-circuits, which each represent a different test parameter, into a base ring oscillator to form a variable ring oscillator for testing a circuit. Rather, Deyhimy teaches switching sub-circuits into the clock signal path to increase the delay in the clock signal path. Once, the sub-circuit is switched into the clock signal path, it cannot be removed since Deyhimy teaches using a fuse to disconnect the sub-circuit from the clock signal path. Accordingly, one could not use these references to arrive at the subject invention since neither of the references teach producing a variable ring oscillator from a base ring oscillator and at least one of a plurality of sub-circuits.

Furthermore, Deyhimy teaches selecting particular values for resistors and capacitors in which the delay of a given sub-circuit differs from the delay of another sub-circuit by a power of two. Deyhimy is solely concerned with selecting values for the resistors and capacitors to easily control the amount of delay that is added to the clock signal path and not for conducting parameters tests as taught in the subject invention. Thus, Deyhimy does not teach selecting values for resistors and capacitors for parameters tests.

In contrast to the Deyhimy and Bach references, claims 37 to 43 of the subject invention depend from amended claim 34 which specifies that the subject invention is directed towards testing an integrated circuit on a wafer with a test circuit that includes a base ring oscillator and a plurality of sub-circuits that can be selectively switched into the base ring oscillator to form different versions of a variable ring oscillator.

Accordingly, the Applicant respectfully submits that claims 37 to 43 are inventive over the Bach and Deyhimy references and should be allowed.

The Applicant further submits that, typically, integrated circuits are built with a polysilicon layer and a plurality of metallization layers (sometimes up to nine layers). The invention as claimed, in at least some of the claims, may be fabricated and become operational before the final metallization and passivation steps of a standard CMOS process. Neither of the cited references provide this advantage.

CONCLUSION


In view of the foregoing comments, it is respectfully submitted that the application is now in condition for allowance. If the Examiner has any further concerns regarding the language of the claims or the applicability of the cited references, the Examiner is respectfully requested to contact the undersigned at 416-957-1697.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

BRIAN H. MOORE

By



Stephen M. Beney
Reg. No. 41,563
Tel: 416-957-1697